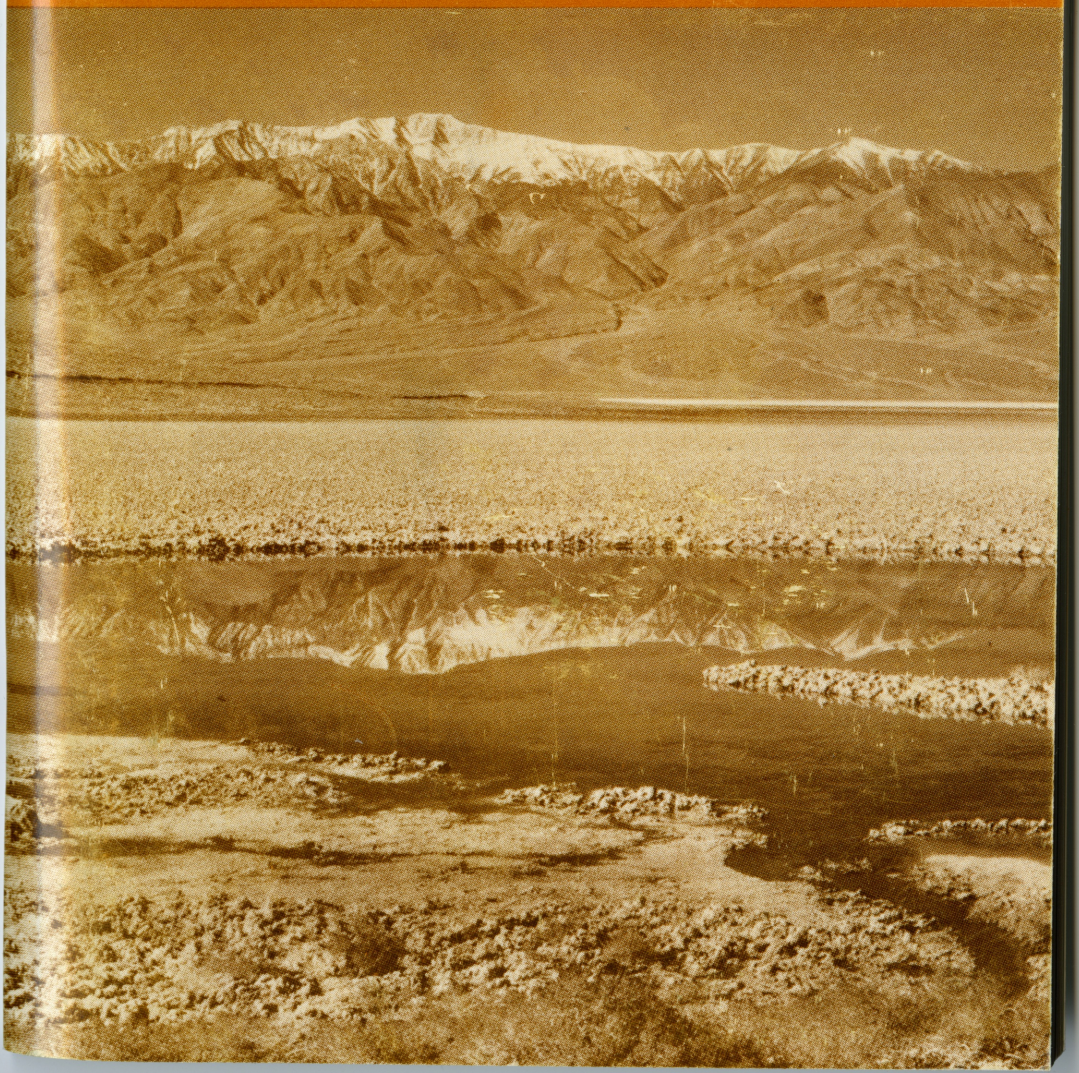
A NATURALIST'S DEATH VALLEY

(REVISED EDITION)

By DR. EDMUND C. JAEGER



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By EDMUND C. JAEGER, Sc.D.
Curator of Plants
Riverside Municipal Museum
California

Pen sketches by
Edmund C. Jaeger
Morris Van Dame

Photographs by
N. Curtis Armstrong

Publication No. 5
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Preface

The complete natural history of Death Valley will never be written. The remarkable adaptations of its many plants and animals to their arid environment and their relationship to one another is a subject too vast. Any of the chapters of this booklet could easily have been enlarged to a sizable volume if the subjects were adequately covered.

To know even a few of the wild flowers, trees, shrubs, reptiles, birds and mammals will add enormously to the total pleasure which can be derived while camping or traveling under Death Valley's sunny sky. Interest in them is certain to grow as we further enlarge our acquaintance with them. The observing traveler must soon notice how closely the peculiarities of the marvelous scenery depend not only upon geological formations and topography but also the form and color of the plants and the presence and work of the animal denizens: even the humbler ones have their share in producing the general effect.

Here we have in a Naturalist's Death Valley a rapid sketch (or shall we say a primer?) to further help the thousands of admiring visitors get a general picture of Death Valley National Monument's natural history features.

For the many courtesies extended in giving information and aid in pursuing his Death Valley studies at various times the author wishes to record his gratitude to Gerald A. Becker and Dr. Thane McCulloch; Merdith B. Ingham, Park Naturalist; Burr Belden, feature writer, and N. Curtis Armstrong, photographer of the San Bernardino Sun, who supplied most of the beautiful photographs.

EDMUND C. JAEGER

Clarke Botanical Section,
Riverside Municipal Museum
August 30, 1957

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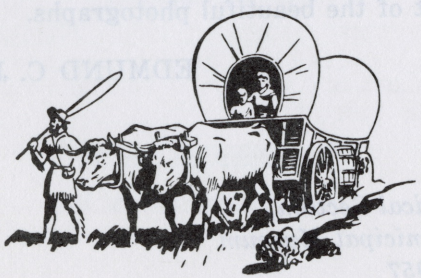


CHAPTER 1

General Description . . .

Death Valley is an enormous trough approximately 140 miles long and four to sixteen miles wide, extending north and south between high colorful bold-faced mountains. The Grapevine and Funeral Mountains are on the east, the Panamint, Cottonwood and Last Chance Mountains on the west. Its lowest parts vary in altitude from –282 feet to at least 2000 feet above sea level. This *graben* (German for trench or ravine) as the geologists like to refer to it, is believed to have been formed by gigantic earth movements called faulting, and down-dropping of those parts of the Valley which lie between the mountains. The relentless forces of erosion have since ceaselessly been at work. As viewed by the geologists, Death Valley is considered a part of the Great Basin. Because of its plant affinities, the botanists think of it as a part of the Mohave Desert.

At one time not so long ago (Pleistocene) the climate of this area was much more humid than at present and the yearly rainfall probably was between 10 and 20 inches. Where now are almost barren undrained basins and valleys and almost treeless mountains, forests of small trees, including pinyons, junipers, scrub oaks and a dense to open chaparral formation of small shrubs, much as now exists at higher elevations (6000-8000 feet), covered the land. In the open spaces were many kinds of grasses. Animals such as the mastodon, horses, camels, sloths, antelope, and some of the larger cats roamed at large. Evidence of this is found in fossil tracks found in such places as the Salt Creek Hills, lying south of the Devil's Cornfield and actual fossil bones in Titus Canyon.

This was the time when deep and narrow Lake Manly and contemporary smaller Lake Rogers to the north were fed by waters derived from melting snows and ice in the High Sierra and other surrounding mountains to the east

and south. Death Valley must then have been a place of ever-fresh beauty with the blue waters of lovely lakes mirroring the contrasting shades and lights and colors of the precipices and rocks of the surrounding rugged mountains.

As the climate gradually changed to become more and more arid, much of the plant cover died out, especially in places of lower elevation, and a new flora (and with it a new fauna), adapted to the severe conditions of great heat and almost continuous drought, came into being. From the arid interior of Mexico (Sonora and Chihuahua) shrubs such as the creosote bush and burrobush advanced into the area; also, many desert-loving herbaceous perennials and annual flowering plants found in the newly created arid lands, places suited to their growth. Thus gradually was developed the present complex and unique flora. Some few of the plants of a bygone age still exist in decreasing numbers in some of the favorable out-of-the-way corners of the Monument. Sporadically in wet years they may be found flowering; then for a considerable number of dry years they are wholly absent. Only because of their long-viable seeds are they able to persist.

Young kit fox

CHAPTER II

Indians of Death Valley . . .

There are yet a few Indians (five or six families) in Death Valley. Most of them winter, as did their ancestors, in the vicinity of the Furnace Creek Ranch. Their summers are spent at nearby Shoshone or at Beatty where it is higher and cooler. When white men first came into the Valley, there were Indians living during the cooler months also near Tule Springs (near where the Manly-Bennett party camped in 1850), at Surveyor's Well north of the central part of the Valley, at Mesquite Springs and in some of the canyons carrying streams of water such as Grapevine Canyon, Johnson Canyon, Hanaupah (Indian name for bear-water) Canyon and Cottonwood Creek.

They belonged to the Panamint (Shoshone) tribe which with some of their Shoshonean-speaking neighbors (at Ash Meadows, Panamint Valley, Saline Valley, Eureka Valley, Amargosa Desert) occupied a wide sector through the most arid parts of California and Nevada. The exact boundaries of their original territory are not known. Just outside of Death Valley there were Shoshone people at Hot Springs, at the mouth of Hall Canyon (now Indian Ranch Reservation) on the west side of the Panamint Mountains, at the lower end of Hunter Creek on the west side of Saline Valley, and at Beatty. There were occasional to frequent cultural exchanges between them and some of their neighbors, especially at the time of their communal rabbit drives and antelope hunts and the fall festival held after engaging in the pinyon nutting expeditions.

In their efforts to gather food and hunt, these people roamed over an extraordinary range of life zones: they wandered over or camped in the Coso, Argus, Inyo, Panamint, Cottonwood, Last Chance, Nelson and Grapevine Mountains and in the broad, mostly barren, summer-torrid valleys in between. In all this area there were probably

never more than 500 Indians; there may have been many less.

Such archeological studies as have been carried on in Death Valley indicate that people were living in this area at least as long ago as 6000 B.C. With a few interruptions they have continued to live here to the present. The period of long severe droughts following the disappearance of Pleistocene Lake Manly probably made the region from time to time uninhabitable. When a more moist and cooler climate again prevailed (Little Pluvial times) Indians again lived here. These early inhabitants were primarily hunters. A desert culture based upon seed gathering, with hunting playing a minor role, appears not to have been established until the advent of the Christian era or "perhaps not until a thousand years later." (Wallace)

Shoshoneans probably came into the Valley from the east where they were already accustomed to a desert way of life.

A great wealth of archeological remains and evidences of former occupancy have been found around the mesquite dunes, especially in northern and central Death Valley. Fragments of pottery are present around many of the old camp sites; also side-notched points, milling stones, hand stones and other plant-preparing instruments.

It must be pointed out that private collecting, except by recognized universities and museums, who have permits from the Secretary of the Interior, is forbidden in National Parks and Monuments. People who by chance happen to run onto caches of artifacts are asked to leave them in place and notify the rangers. Then the materials are properly recorded and the finder's name is included in the Monument Museum's record as having made a contribution to archeological knowledge.

The life of the Death Valley Indians was based upon an almost constant search for food. This caused them to follow the ripening vegetation from low Valley floor to high mountains. Their Valley living sites (really seasonal camps) were amongst the mesquite thickets. When the winter stores of seeds, roots and pine nuts were exhausted in March or April and hunger became acute they began to live on greens. Wild mustards and the new leaves of prince's plume (*Stanleya elata*) were gathered. Leaves of the latter herb were repeatedly boiled and the water drained off to re-

Panamint Indian mother and child. From an old print by an unknown photographer. Note gathering basket behind and winnowing basket in foreground.

move the poisonous selenium which this plant readily absorbs. Seeds of the Indian rice grass (*Oryzopsis*) and of other plants such as ephedra, chia, evening primroses and blazing stars were gathered in their season by beating them with aid of a wickerwork paddle into large cornucopia-shaped baskets. Mesquite pods were eaten green in April; when ripe in June, they were pounded up in wooden mortars fashioned from trunks of the mesquite tree. From the "flour" a loaf or a porridge was made. These people had pottery: much cooking was done by dropping fist-sized, red hot stones into a water-tight coiled-work "pot basket" which held the gruel. The stalks of the reed (*Phragmites*) were dried then pounded up and made into cakes and roasted until it formed a sweet taffy-like mass. After the thorns were removed, flat-stemmed cactus joints were steamed in

earth-covered pits and eaten, or dried in the sun, then boiled when needed. In late summer edible roots were mature and eaten.

In the latter part of September families went to the highest mountains for the important pinyon-nut harvest. With long poles, sometimes hooked, the cones were brought to the ground and were either spread in the sun to dry or roasted in fires to free the nuts; or the seeds, having naturally fallen when ripe, were picked up from the ground. It was a busy time of good feeding. Excess nuts were either stored in the mountains or taken to the winter camps on the Valley floor. For these Indians pinyon nuts were indeed the most important crop of the year. It was a food that carried them through the long winter.

The annual rabbit drive, which generally took place in October, united many families from over the Valley and nearby habitations. Only men took part in it and the drive lasted about a month. A feast was held at the end of each day. Men, "all yelling like coyotes" and beating the brush, drove the frightened rabbits against long 2-foot high nets held up by poles; then others, standing by the nets clubbed the luckless ensnared creatures to death.

The skins of the rabbits were cured, cut into strips and twisted into lines, then woven or sewn together to make blankets. The meat was sometimes dried. Communal antelope hunts held near Searles Lake and perhaps managed by a shaman who was supposed to capture the antelopes' souls, and so render them stupid, consisted of driving the animals into brushmade corrals where they were killed with bow and arrow. Deer were stalked singly and shot with poisoned arrows. Mountain sheep were taken in like manner in limited numbers just before the time of the nut harvest.

They dug rodents (pack rats, chipmunks and ground squirrels) from their hide outs in trees or burrows or ran them down and killed them with sticks or stones. All reptiles, from chuckawallas to the smaller lizards and snakes, except the rattlesnake, were eaten. Insects of many kinds from grasshoppers to larvae of sphinx moths added further variety to their fare.

Among the pieces of Shoshonean handiwork were well-made skull caps, shallow bowls of coiled grass stems over woody withes of willow or squaw bush, and water baskets of coiled work pitched within and without with pine gum.

The coils were sewed with strands of willow: If there were black basket patterns they were made from the pods of devil's claw (*Martynia*) or rush (*Scirpus*) soaked in ashes. Red dyes could be made from the roots of the tree yucca. They had carrying nets made from fibers of Indian hemp.

Using arrowweed they constructed small conical sweat houses, covering them with mud. Their arrows were made from willow, or from common cane (*Phargmites*) with points from the hard wood of the creosote bush or greasewood (*Sarcobatus*). Juniper from the mountains gave them materials for bows. To add elasticity and strength these were backed with sinews from deer. Sinew or twisted Indian hemp fibers were utilized for the cord.

Circular wickiups about six feet high made of willow or mesquite for support and brush or tules for cover, were the summer shelters. A conical modification built over a one-foot-deep circular pit served as the winter house. A hole in the top served as an outlet for smoke from the central fireplace. An old wickiup found in 1953 buried in the sand of the Valley's central area was unfortunately destroyed when the airport was built.

Along trails leading to water and near springs are incised pictures and signs, all evidence of man's early desire to leave some record of his presence and activities. Some of these petroglyphs may have served as directional signs. Just what people made them is conjectural.

When a man desired to marry a girl he gave her valuables (perhaps worth $20) which she gave to her mother, who in turn showed her goodwill and approval by giving food to the man's mother.

The pair lived with the wife's mother until the first child was born. Many of the children died young. Large families seldom existed.

The important "fall festival," which took place after the rabbit drive and pine-nut harvest, opened with an "exhibition dance" by men from nearby Saline Valley. They were paid in goods and shell money. Following this came the burning of goods collected at the funerals of the year's dead; last was the "circle dance" which might go on from one to several nights.

Few of the old Shoshonean rites and customs prevail today; pine-nuts are seldom gathered; the trails have been

forsaken, the rabbit drives and the festivals have been largely forgotten. For me a pathetic loneliness now pervades the land that was once the abode of a brave people with an interesting history and unique economy. They had learned to live adequately and for the most part in contentment in an austere desert where their modern white brothers would perish.

Pack rat

CHAPTER III

Mammals of Death Valley National Monument . . .

Those who think of Death Valley only as a place of sun-scorched flats and surrounding broad detrital fans issuing from the steep narrow canyons of the colorful barren mountains, have little idea of the real number of mammals to be found in the entire two-million-acre Monument. On the valley floor the mammal population is indeed small but in the higher parts of surrounding bush- and tree-covered mountains, some of which rise to more than 11,000 feet altitude, mammals, especially the small agile rodents, may actually in places be rather plentiful. Dr. C. Hart Merriam and his companions, Vernon Bailey and Frank Stephens of the Death Valley Survey in 1891, named the broad bush-covered area where the highway now passes across the head of Emigrant Canyon (alt. 5200 feet) Perognathus Flat (now Harrisburg Flat) because of the unusual abundance of pocket mice (genus *Perognathus*) there. Dr. Alden Miller of the Museum of Vertebrate Zoology at Berkeley, California and Dr. Lowell Summner, Jr., found many of the pinyon, juniper and bush covered mountain slopes and flats very good areas for collecting mammals. Their studies made it possible to include in the list of Death Valley National Monument a number of mammalian species not hitherto seen or even suspected there. If our wanderings take us into such places as Cottonwood, Hanaupah or Surprise canyons where there is water and trees such as true willows, cottonwoods and mesquite, the chances of finding mammals is much increased, even at lower elevations.

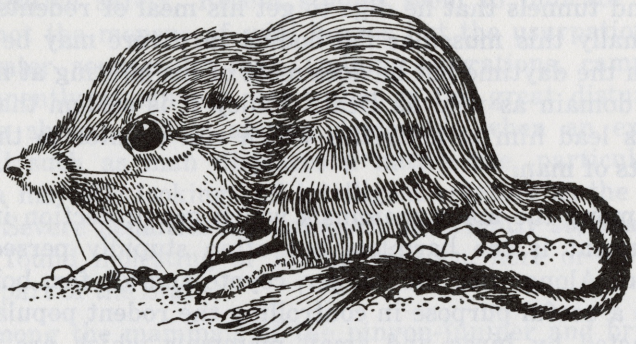
Travelers passing over the roads of the Valley floor by day rarely see the small gray round-tailed ground squirrel but the lively antelope ground squirrel with tail carried jauntily over its back is common. The black-tailed hare,

frightened by their approach, may leap across the road at night or a handsome big-eared kit fox, a lean coyote or an occasional kangaroo rat may also be glimpsed. Many small rodents such as the white-footed mice, which subsist mostly on dry seeds and live without water, are little known to the average Death Valley visitor because they are active only at night. Rarely a shy badger or a spotted skunk is found. Both live mostly on wild mice and ground squirrels; the skunks' bill-of-fare includes in addition a few insects.

Wherever there is brush or trees the bulky conical "stick and chip" shelters of the pack- or trade-rats are evident. The neotomas, as the scientists prefer to call them, are particularly fond of the dense mesquite thickets. There, building material is unlimited, and food, whether it be mesquite beans or green leaves, is almost always bountifully present. Up in the rocky brush country the pack-rat "houses" are much less bulky and are made of irregular collections of sticks, stones, dung, twig ends and almost any other sort of small moveable objects. These materials are usually placed between rocks or in an overhanging or cavelike shelter. The animals are as a rule strictly nocturnal in their activities. In the mesquite thickets they can be heard all through the night cutting twigs or running about over the branches. A flashlight may enable one then to see the big-eyed, big-eared, nimble creatures in action.

The abundance of all these furred creatures varies much over any long period of years. Extreme drought and disease, from time to time, exact a heavy toll of their numbers. During times of more plentiful rains they make a surprisingly quick "comeback." Among the great enemies of small mammals are the summer cloudbursts. Then huge quantities of water coursing down the numerous canyons wash many from their burrows and drown them.

In the months of March and April when the mesquites are colored yellow with their myriads of catkins of small flowers, veritable "clouds" of little canyon bats of the genus *Pipistrellus* pour out from their hide-outs in the canyon cliffs to feed from dusk to midnight hours on the numerous gray noctuid moths and other insects which hover about these leguminous trees. Other bats known from the lower elevations (2000 feet to below sea-level) are the migratory hoary bat, the little pallid bat and the Yuma bat. The little pipistrellus mentioned above is best known to Death Valley visitors because it appears soon after sundown while it is yet quite light.



Kangaroo rat

Ring-tailed cat

The presence of a badger is usually indicated by the large mounds of earth about the entrance to the underground tunnels that he digs to get his meal of rodents. Occasionally this muscular flat-bodied carnivore may be seen out in the daytime but he does most of his hunting at night. In a domain as wild as Death Valley it is seldom that his habits lead him to activities which run counter to the interests of man.

Among the many mammals which get protection in the Monument is the harmless but often stupidly persecuted bobcat. Along with the badger, coyote and kit fox, bobcats serve a useful purpose in controlling the rodent population. Attracted by birds and small mammals which are more abundant about water and cultivated areas they are sometimes seen at dusk or in the early morning hours at such places as Furnace Creek Ranch, Grapevine, Saratoga and Sand Springs. They are more plentiful in the brush cover of the higher elevations. Ring-tailed "cats" are sometimes met with about old mines. They are exceedingly gentle and certainly good looking creatures. Wherever there are kangaroo rats in fair numbers, especially the big kangaroo rat, which is partial to sand flats and dunes, there you will find the beautifully furred kit fox. He is the desert's daintiest larger mammal. Quite often he may be observed at night either crossing the road in front of the head lights or coming around the camp fire, tempted there by the odors of food or just to satisfy his extraordinary and endless curiosity. A bit of food thrown out may give one a chance to see at close range this innocent looking and graceful carnivore. Many are the nights his light feet travel over the sands and across the Valley to areas among the mesquites and salt bushes where wild mice dwell. In places along the bed of the Amargosa River and at Saratoga Springs and similar places where grasses and some green vegetation is found he may find meadow and harvest mice to add to his fare.

Where sheer cliffs and parapets, rocky terrain and sparsely shrub-covered slopes offer protection, several hun-

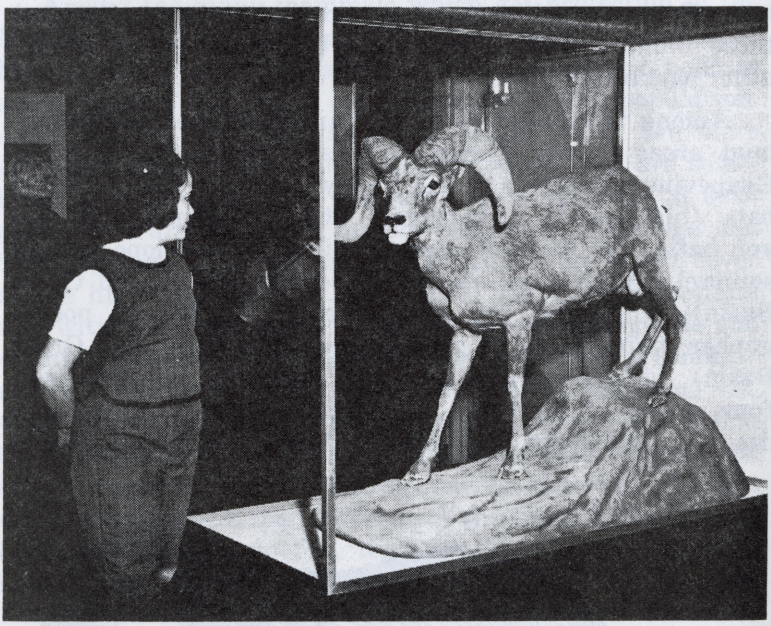
dred Nelson bighorn (named in honor of Dr. Edward W. Nelson, long time chief of the Biological Survey) live in comparative safety. Recent studies seem to indicate that it is not the menace of wild burros but the usurpation of the water sources by man (mining operations, camping permanently at springs, etc.) that is the great disturber of the sheep. It is always deplorable when an exotic animal such as man displaces a native one, particularly such a majestic looking and intelligent creature as the bighorn. Severe penalties are assessed, and rightly so, against those found molesting or killing bighorn, here or in any other part of the State.

Among the mammals of the pinyon-juniper and brushland areas of the Panamint, Last Chance, Funeral and Grapevine mountains of the Valley's rim are four kinds of bats (black-nosed, long-legged, little California and canyon bats), the lively Panamint chipmunk, antelope ground squirrel, badger, two species of coyote (desert and Great Basin), ring-tailed cat, Arizona gray fox, bobcat, pocket gopher, two species of pocket mice (long-tailed and Great Basin), big-eared harvest mouse, Panamint kangaroo rat, four species of deer mice (common, Stephen's, pinyon and desert), two kinds of woodrats, lesser California ground

Round-tailed ground squirrel

squirrel, two species of cottontail rabbits (Nuttal and Audubon's), mule deer, Nelson bighorn and porcupine.

Some of these mammals are known also from lower elevations to the below-sea-level floor of Death Valley. Good evidence is this of the unusual adaptability of these creatures to varied conditions.



A native Nelson Bighorn in the Death Valley Museum

CHAPTER IV

Some Birds of Death Valley . . .

"Birds in Death Valley!" I recently heard a man exclaim. "I didn't suppose there were any there except once in a while a raven or carrion hunting buzzard." Much surprised he was when he read in a pamphlet published by the National Park Service for Death Valley visitors that over two hundred different kinds have been seen. Of course this number includes migratory as well as the much fewer resident birds; it embraces kinds which dwell in the Monument's high mountains as well as those which habitually frequent the Valley floor.

Probably the most often seen bird is the big black sagacious raven. Even on the hottest days he may be observed aloft as he keenly looks for food—lizards, snakes, an occasional small rodent or some scraps thrown out by some camper. On extended wing he soars and soars, taking advantage of the many shifting wind drifts. Coarse and gutteral is his lonely note. If you are still he may fly very close or even walk on the ground as he makes his inquisitive observations.

Competing in part with the raven for food is the turkey vulture. Both black birds soar but even at a distance the vulture can readily be distinguished by the position of the outspread wings which in flight turn up slightly at the tips. A diagnostic patch of gray is on the underside of each wing. This bird is not present in winter.

Other high flying soaring birds likely to be seen are the large red-tailed hawk, the Cooper and the sharp-shinned hawk and the daring-flighted prairie falcon which nests in high cliffs. Wide spread is the beautifully marked, graceful-flying sparrow hawk.

At night the deep-toned call of the Pacific horned owl is heard coming from the rocky gorges.

1. Phainopepla • 2. Raven • 3. Le Conte Thrasher
4. Horned Lark • 5. Rock Wren

That handsome crested black aristocrat of small birds seen atop the higher branches of the mesquite thickets is the phainopepla. It however is only a winter visitant and never plentiful even then. Where on the valley floor there are wide open spaces near the mesquite thickets atop which he can find lookout posts the handsome gray, black and white logger-head shrike with mask of black, is certain to be seen. Similar situations are occupied by the mocking bird. The rarely found Le Conte Thrasher spends much time aboard the mesquites too. The latter's spirited and sweet whistle or rolling song can best be heard in spring when light first appears above the rim of the eastern mountain borders.

Furnace Creek Ranch is an especially good place to get acquainted with birds of the Valley floor. The water of irrigation ditches, the grass, the shade of trees, particularly that of the large introduced evergreen athel (*Tamarix articulata*), induces many birds to come there throughout the year. Spring and summer migrants often stop there and in late autumn one sometimes occasionally finds bird visitants from the nearby mountains. These may include Bewick wrens, western Mexican bluebirds, western robins, black-throated gray warblers, pipits, red-shafted flickers. and Woodhouse jays. A few water birds frequently may be sighted from time to time not only at Furnace Creek but at some of the perennial springs and seeps; among them greater yellow-legs, Anthony green herons and killdeers. Many kinds of ducks stop to rest temporarily in the water as they pass north or south in migration.

Writing of birds seen at Furnace Creek Ranch in the latter part of October of 1933, Dr. Joseph Grinnell has the following interesting note:

"One afternoon at 4:00 we visited the Ranch wood-pile. The tiers of dry mesquite gave forth sound as of gentle rain—sound from gnawing of innumerable larvae of powder-post bettles. And here upon our arrival were about a dozen English sparrows in company with Audubon warblers, a Say phoebe and a shrike, catching the emerging adult beetles. The sparrows would often fly up from perches on the wood-pile and catch the beetles in flight."

The English sparrow, eager always to occupy every possible ecological niche, came by means no one knows, into the Valley sometime during the first World War. Dr. Joseph Grinnell first reported it in 1919; it was then already well established at Furnace Creek Ranch.

Dr. Alden Miller of the Museum of Vertebrate Zoology at Berkeley, California, gives us a list of summer resident birds observed in the juniper pinyon area (alt. 6500-8000 feet) of the Grapevine Mountains in the last part of May and early June.

Turkey Vulture
Red-tailed Hawk
Golden Eagle
Mourning Dove
Horned Owl
Saw-whet Owl
White-throated Swift
Broad-tailed Hummingbird
Hairy Woodpecker
Ash-throated Flycatcher
Gray Flycatcher
Violet-green Swallow
Holarctic Raven
Mountain Chickadee
Bush-tit
Bewick Wren
Rock Wren
Mountain Bluebird
Gray Vireo
Black-throated Gray Warbler
Black-headed Grosbeak
Cassin Finch
Arkansas Goldfinch
Green-tailed Towhee
Black-throated Sparrow
Oregon Junco
Chipping Sparrow
Black-chinned Sparrow
Cooper Hawk
Ferruginous Rough-legged Hawk
Prairie Falcon
Screech Owl
American Long-eared Owl
Poor-will
Costa Hummingbird
Red-shafted Flicker
Downy Woodpecker
Say Phoebe
Western Wood Pewee
California Jay
Pinyon Jay
Plain Titmouse
White-breasted Nuthatch
Canyon Wren
Mockingbird
Blue-gray Gnatcatcher
Audubon Warbler
Scott Oriole
Lazuli Bunting
House Finch
Red Crossbill
Spotted Towhee
Bell Sparrow
Gray-headed Junco
Brewer Sparrow

See ADDENDA page 70

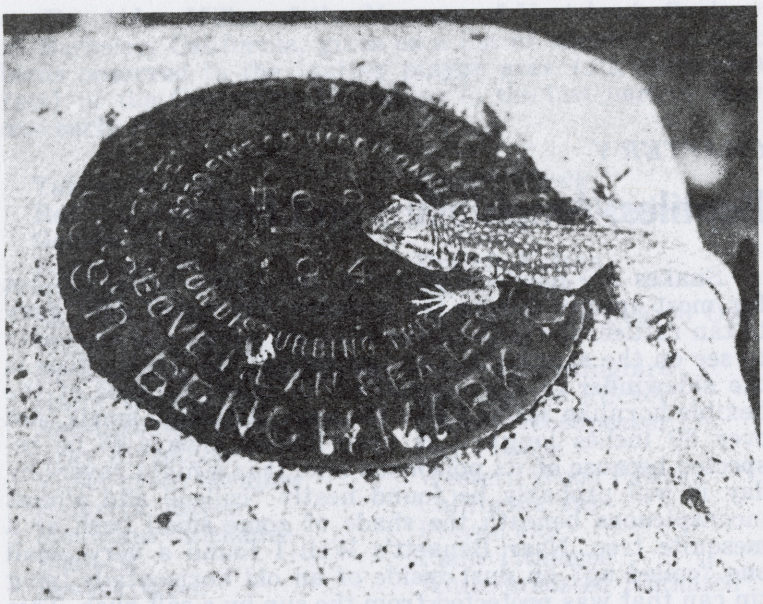
CHAPTER V

Reptiles, Amphibians and Fishes . . .

Snakes are nowhere plentiful, the Valley being too hot for most species during the summer. The small light gray to tan rattlesnake with the keeled back which you are likely to see on the sands, clays and gravels of the Valley floor is the sidewinder or horned rattler, so called because of the flexible hornlike scales above the eyes. Although small (not over 30 inches long) it is nevertheless always to be respected because of its poisonous bite. It is a night rover; by day it will probably be found neatly "coiled" and almost inconspicuous beneath the shade of some small bush or a mesquite tree. Near Bennett's Well I found a very small one "coiled up" on dust inside of an old horizontally-lying tin can that was protected from the sun by a salt bush. This small rattler has been seen almost every month of the year. Peculiarly the Mohave rattlesnake, with black tail bands narrower than the sharply contrasting light colored ones, found over much of the Mohave Desert does not enter the Death Valley area. The colorful Panamint rattlesnake occurs mainly in higher rocky mountain areas up to 7000 feet. The red racer, famous for its lithe body and great speed, is quite common on the Valley floor.

Other snakes which should be looked for in the Monument (principally at higher elevations where rodents are more plentiful) are the gopher snake, common whipsnake, western worm-snake, California boa, western shovel-nosed snake, common king snake, long-nosed snake, western patch-nosed snake, lyre snake, spotted night snake, spotted leaf-nosed snake, patch-nosed snake, vermillion-lined ground snake, and Utah black-headed snake.

Lizards of the area comprise seventeen species. Among those of the Valley floor is the banded gecko. It is usually seen about or under rocks and is identified at once by its soft, delicate skin with brown crossbands, and the large



The little side-blotch lizard suns himself on one of the numerous benchmarks of the Geodetic Survey.

eyes with vertical pupils and no moveable lids. The slender grid-iron tailed lizard dashes from view, appearing much like a silver streak on the heated sand. The western whip tail lizard with long tail, and back with numerous sooty brown to black spots, arranged in longitudinal bars, is also a swift runner and is most common where it can seek shelter under bushes. Abroad too on bright sunny days is the very alert, large, heavy-bodied desert crested lizard. It is a blossom and leaf eating species like the chuckawalla. At night it occupies burrows in the sand, the entrances to which it usually plugs with sand. In rocky areas may be found the collared lizard, readily identified by the two collar-like shoulder bands of black, and the spotted body. It is a pugnacious, largely carnivorous species eating other lizards, spiders, crickets, grasshoppers and even very small snakes. Its near relative, the leopard lizard with large dusky spots and whitish transverse body bars, is exceedingly wary and given to living in more open areas where

it stalks its prey with great cunning. Other lizards and insects are its fare. One seen near Triangle Spring had swallowed one of its own kind almost as large as itself. It too is a great speedster, but I have never seen it lift its forelimbs off the ground as is sometimes the habit of the collared and the spotted lizard. Active on warm days throughout the winter months, as well as spring, summer and autumn, is the small but very active ground-dwelling, insect-feeding side-blotched uta. The chuckawalla known for its large size, broad flat body, loose folds of skin on the neck and thick round tail, is ordinarily found only about rocks in the deep cracks of which it can speedily seek shelter when alarmed. Once within its place of hiding it may quickly wedge itself in by inflating the body. Chuckawallas run rather clumsily; also leap from rock to rock as they move in quest of flowers to feed on. The swift Mohave sand lizard may be expected at Saratoga Springs and other areas of shifting sand where it can quickly bury itself out of sight. Small ring-shaped markings of black ornament the body which has a ground color of pale yellow. The toes are fringed with long pointed scales, the head is shovel-like; both are adaptations to its habit of running on sand or quickly burying itself beneath it. The insect-eating blunt-nosed desert horned lizard frequents places where there are low growing bushes. The colors of its flat body resemble so much the gravels on which it lives that the animal is often not seen until it moves. This innocent-looking, gentle horny-headed creature is sometimes eaten by snakes as well as by birds such as the raven. The small smoky-gray night lizard is found only in the few areas where there are dead yuccas (usually tree yuccas) under whose loose bark or insect-tunneled trunks they find the termites upon which they largely feed. Accordingly, they are found only in higher elevations of the Monument.

The desert tortoise does not live on the Valley floor but may be looked for at elevations above 3000 feet. During the wild flower season of spring it is out feeding in the day time but when summer comes it hides under rocks, in burrows or occasionally in the deep shade of bushes. Winter is spent in burrows of its own digging.

The desert toad (*Bufo punctatus*) (1¾ to 3 inches long) frequents places where there is persistent water as at Furnace Creek and in pools about springs. The call is described by Dr. Stebbins as "a clear liquid trill essentially on one pitch." The small Pacific tree-frog is found about water

at Furnace Creek, Cow Creek and in rocky canyons of the Panamint Mountains up as high as 6000 feet (Hanaupah Canyon, Cottonwood Canyon). It was found by members of the Death Valley Expedition also at Saratoga Springs at the south end of the Valley. The frequently given call note, a loud *Kreck-ek,* the last syllable with a rising inflection, is often given in chorus and seems quite out of proportion to the small speckled, sleek-bodied creature that makes it. The male when "singing" may extend the vocal pouch like a bubble out beyond the chin.

At isolated Devils Hole, at Saratoga Springs and in Salt Creek which flows in the center of the Valley, live small gray-bodied fishes called *cyprinodonts,* believed to be descendents of fishes which lived in ancient Lake Manly (named to honor William Lewis Manly [1820-1903] who helped to lead the starving Bennett-Arcane party out of Death Valley in 1849). This body of fresh water approximately 90 miles long, 6 to 11 miles wide, and more than 600 feet deep was formed in Death Valley at the end of the Ice-age (Pleistocene) when increased rainfall and melting ice and snow swelled the streams that drained into the trough. Lake Manly is supposed to have been of comparatively short duration and finally dried up. But in isolated pools, streams and water holes which have persisted the fishes in small numbers have lived on, gradually changing their physiology with the changing conditions such as warmer water, greater salt and alkali concentrations and different food supplies.

It is most interesting to note that similar fishes of the genus *Cyprinodon* are found in detached pools and streamlets of the interior of the Sahara which in the past also contained a large inland lake.

CHAPTER VI

Insects and other Invertebrates . . .

In spite of the aridity of this interior desert region the insect fauna is large and many kinds will be noticed even by the casual observer. Every tree, shrub and flowering plant has its insect visitors. The naturalist will find many which are of special interest because of their peculiar life-histories; some are certain to be undescribed species.

Crickets of several kinds are present including the large brownish black ones, the small sand-inhabiting, nocturnal camel crickets of the dunes, and the loud, night singing tree crickets which are responsible for much of the insect noise heard around thick stands of salt bush and mesquite thickets on warm nights. These last insects are wonderful ventriloquists and are hard to locate on the shrubs they frequent.

During spring and summer the big black diurnal blood-sucking horse flies called tabanids are painful biters and may be very annoying to both beasts and man. The eggs are laid in compact masses on water plants and the larvae live in the mud of ponds and irrigation ditches such as are found at Furnace Creek Ranch. At the same time often appear swarms of tiny black flies called midges. They are not only very annoying when getting about the eyes and ears but are fierce biters as well.

Quite often the robber or assassin flies, with slender hairy bodies and strong legs, may be noticed. Those of desert regions are all somber colored. All are predaceous on other insects. They are sometimes called hawks of the insect world because of their way of taking their insect prey on the wing as well as on the ground. They often rest on the earth or at the ends of twigs where we see them sucking the blood of their victims.

A small brownish sand beetle (*Eusattus*) with tan stripe across the back part of the thorax, crawls in April in numbers on the dunes. Walking on the dunes too may be the large circus beetle (*Eleodes*), called this because "he will

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stand on his head and kick his feet in the air" when disturbed. It belongs to a group of darkling beetles common to deserts in many parts of the world. Tremendously destructive to dead and dying mesquite trees is the mesquite boring beetle, whose larvae are called flat-headed borers. They mine the sap and heartwood making a distinct clicking noise as their strong jaws work (see page 23). There is also a round-headed mesquite borer whose yellowish-white larvae may attain a length of 1½ inches. Such larvae were considered a special food delicacy by the Paiute and Panamint Indians.

In the spring months, small somber-colored moths come in and flutter into the flames of the camp fire. At dusk we see myriads of medium-sized tan ones hovering about and feeding on the nectar of the mesquite flowers. Several kinds of butterflies including the common painted ladies, skippers and the blue or copper-colored theclas with peculiar hair-like tails on the hind wings, fly about in the sunny days of spring.

The painted lady (*Vanessa cardui*), long ago described by the famous Linnaeus of Sweden and now considered the most ubiquitous of butterflies, may in migration during February or March of wet years suddenly invade the Valley in enormous numbers. "Where do they all come from," is a frequent question. At the same time these butterflies may be found in equal numbers on the Colorado Desert to the south, and like those in Death Valley all are traveling in a northerly direction. Many kinds of wild flowers serve as food for larvae and adults.

There are a goodly number of bees, wasps, ants and other insects belonging to the great order Hymenoptera. Many of them are exceedingly small, especially the wasps which feed on flowers. The flowers of the very common sting bush (*Eucnida*) of the canyons almost always have some small bees at work in them. The biggest of the wasps is the beautiful flower-feeding tarantula hawk. Its body is metallic steel-blue, its wings orange or fiery-red. It preys on tarantulas or other large spiders and after paralyzing them with its sting, stores them in the ground as food for its larvae.

In the few small streams and water holes of the mountains and Valley floor quite a number of water dependent insects may be seen. My good friend, Dr. William H. Thorpe found in the saline waters of this desert area many unusual

Klare Spring the only water in Titus Canyon. In the foreground rabbitbrush. Behind, arrowweed and the common cane (Phragmites). On the canyon-side grows a species of salt bush.

and interesting species. The larvae of a small ephydrid fly, once much prized as food by the Indians, live in the salty waters of Salt Creek.

In the pinyon forests of the Panamint and Grapevine Mountains is a rather large dull gray grasshopper with beautiful pale-blue membranous under-wings which show up well in flight. During the hot sunny hours of summer it has a curious way of suddenly flying upward in dramatic vertical circles, at the same time making a very loud and startling prolonged clattering noise. This has earned for it the appropriate name of the fire-cracker grasshopper. Once you have seen its performance you will never forget this noisy acrobat of the insect world.

In this short chapter it is possible to mention only very briefly a few of the spectacular or often-seen insects. Get acquainted at least with these; their recognition and study will add enormously to your pleasure while visiting in this enchanted land.

To those who associate snails only with places of green vegetation, perennial dampness and the water of streams and ponds it must come as somewhat of a surprise to learn that in the rock slides and under vegetable debris of Death Valley's bordering mountains are several kinds of land snails. Moreover, Death Valley has the distinction of offering sanctuary to a water snail which is the only soft-bodied invertebrate animal in the world known to inhabit a saturated salt solution. This minute, thin shelled snail, described by the mollusk specialist Dr. S. Stillman Berry of Redlands, California, as *Asiminea infirma* (Latin *infirma,* lowest) was discovered at Badwater near the lowest spot on the American continent by Allyn G. Smith of Berkeley, California, in 1937. He found it living among crevices of crystalline salt among the roots of a salt-loving plant called *Allenrolfia* and in runnels where water comes into the main Badwater pool. Its nearest relative is an *Asiminea* from the saline water of Newport Bay (and once at Mission Bay) an arm of the Pacific Ocean. It is thought possible that in times past the ancestors of these snails were brought into Death Valley on the feet or feathers of water birds. With the shrinkage in size of the once larger Badwater pools and greater salinity the snails adapted themselves to live in the highly mineralized and warmer waters.

Most of the land snails mentioned above are found in the Panamint and other adjacent mountains. It will not be sur-

Death Valley's marvelous dunes. A few creosote bushes, burroweed and a number of annual plants grow in the sheltered flats.

prising if nearly related kinds are found in the higher part of the Grapevine, Cottonwood and Last Chance Mountains. If discovered the find will probably be credited to some patient naturalist turning over rocks or delving into the shale of rock slides of the mountains' north slopes.

One of the snails of the Panamint Mountains (Johnson Canyon) and of the adjacent Argus Mountains bears the name of *Helminthoglypta fisheri* and belongs to a genus

widespread in other parts of the Mohave Desert. Each small dime-sized shell is beautifully marked with a band of brown. Empty shells are more often found than those harboring living animals. Another land snail (*Micrarionta argus*) comes from the Argus Mountains. *Micrarionta hutsoni*, named to honor an Arizona mining engineer, was located 5 miles south of Ashford Mill in the Owlshead Mountains.

A number of fresh water snails may be collected in Death Valley at the large pools at Saratoga Springs and in other fresh water ponds. Among these is *Amnicola micrococcus*, *Bythinella protea* and a small *Physa*. Unfortunately none of these have vernacular names.

Fossil mollusks of a number of kinds are found in rocks of marine origin in several parts of Death Valley, among them ammonites.

A clump of Mohave red-head or cottontop cactus; to the left deer horn straw-top cactus. Note banded hills of colorful rocks behind. This is on the road to the Race-track.

CHAPTER VII

Trees . . .

Only about a dozen trees and "half-trees" (such as the smoke tree, desert willow, mesquite and screw bean) are found in the Death Valley area. In the sands of Smoke-tree Canyon at the far lower end of the Valley the heat-loving Sonoran Desert smoke tree (*Dalea spinosa*) is found. Due to its rarity and isolation few Death Valley visitors ever see this delicate, silvery-blue-green spiny plant. This is without doubt the most northern point of occurrence of this charming species. Two other leguminous "trees" found at low elevations are the honey mesquite (*Prosopis juliflora*) with its finely divided, enlongated green leaves and pale yellow flowers arranged in catkins, and the screwbean mesquite (*Prosopis pubescens*) with gray-green foliage, gray barked stems, prominent whitish thorns and peculiar tightly twisted beans. The honey mesquite grows in considerable abundance in quite a number of places, especially on clay and alkali flats in the lowest parts of the Valley floor; often it forms large almost impenetrable thickets. Its presence indicates rather shallow ground water and it is tolerant to considerable concentrations of alkalies and salts. Cattle and donkeys browse the tender leaves. Its shade, its long yellowish tan beans and the sweet odored flowers attract a considerable number of birds and insects. Pack rats, several kinds of wild mice and the sidewinder often adopt the mesquite thickets as their home. The mesquite bean, when ripe, furnished one of the major foods of the aboriginal inhabitants. The screwbean mesquite with more upright habit also grows in colonies where shallow underground water is readily available but is nowhere common. Stands of this small tree are found at Furnace Creek, at Cow Creek and several other places. It too shows much tolerance to highly mineralized soils. Its thorny branches are favorite nesting sites for the small peppery-tempered bird, the verdin.

Juniper-pinyon forest in the Panamint Mountains.

Peculiarly the catsclaw (*Acacia greggii*) widespread on the Colorado and Mohave deserts is not found. Its northernmost distribution is in the Providence Mountains to the south. *Chilospsis linearis,* the desert willow, which frequently grows in the larger sand washes of the Mohave and Colorado deserts enters only the very southern end of the Death Valley area near Cave Springs. The small statured, narrow-leafed willow (*Salix exigua*) wide spread on our deserts is found in the canyons where there is water. Several other willows (*S. goodingii, S. lasiolepis* and *S. laevigata*) may occur growing in similar situations along with Fremont's cottonwood (*Populus fremontii*). The cottonwoods with their lovely gray-barked contorted trunks and ever-moving leaves, form refreshing areas of shade and green along such a streamlet as is found in Cottonwood Canyon. The water birch (*Betula fontinalis*) has been seen at Birch Spring (alt. ca. 8000 ft.) at the upper end of Jail Canyon. In upper Butte and Hanaupah Canyons are

small specimens of the water-loving Sierra maple (*Acer glabrum*).

Yuccas so frequent in most parts of the mountains and broad basins of the southern and eastern Mohave Desert are poorly represented in the Monument. Rather small specimens of the tree yucca (*Yucca brevifolia*) are seen by the motorist as he passes along the west side of the Panamint Mountains where the road passes over the flats of upper Nemo Canyon; also, as he goes southward to the Racetrack. Tree Yuccas are found on the upper north side of the Grapevine Mountains too; there I was not surprised to find Scott's oriole nesting. It is a bird for the most part definitely linked with yuccas. As the Monument is further explored the Mohave yucca (*Yucca schidigera*) should be seen.

As the motorist looks upward onto the Panamint Mountains' higher west slopes he will see forests composed of numerous small dark-colored trees. Most of these are two to four hundred year old Nevada pinyons or one-needle nut pines (*Pinus monophylla*). Among them will be scattered the spreading California juniper (*Juniperus californica*) or, at higher elevations, the Utah juniper (*Juniperus osteosperma*) of more upright habit of growth. Pinyons are not so common on the Death Valley side of the Panamints due to the dryness of the steep rocky slopes. Pinyons make up a beautiful, dense but small forest on the upper parts of the Grapevine Mountains' north slope. On the very topmost parts of Telescope Peak scattered individuals of two other conifiers are found: a white pine, the limber pine (*Pinus flexilis*) and a yellow pine, the larger trunked, rare bristlecone pine (*Pinus aristata*), so called because of the prominent sharp bristles on the ends of the cone-scales. Both trees have needles in bundles of 5. Near the summits of two of the highest points of the Grapevine Mountains a few scattered limber pines also grow; on one summit *Pinus aristata*. As you stroll along the Mahogany Flats-Telescope Peak trail studying the trees you may vary your botanical studies by looking out for flocks of pinyon jays, or for the Woodhouse jay, Clarke's nutcracker, mountain blue birds, several kinds of juncos, the ruby-crowned kinglet, the sweet-singing Townsend solitaire, the red crossbill, the cheerful singing mountain chickadee, hairy woodpecker or brush nestling green-tailed towhee; all are summer residents and definitely associated with trees.

CHAPTER VIII

Wild Flowers of Death Valley . . .

The first serious attempt to study the fauna and flora of the Death Valley area was made in 1891 when, under the direction of Dr. C. Hart Merriam, Frederick V. Coville, Dr. A. K. Fisher, Frederick Funston (later Major Funston), T. S. Palmer and E. T. Nelson spent 8 months (Jan. 3 to Aug. 28) observing and collecting animals and plants, not only in Death Valley but in a wide area surrounding it. Traveling was laborious but doubtless pleasantly done, mostly on foot and horseback. The results of these studies were summarized in two "Death Valley Reports," one issued by the Division of Botany of the United States Department of Agriculture as Contributions from the United States National Herbarium, Vol. IV; the other, by the Division of Ornithology and Mammalogy of the United States Department of Agriculture, as North American Fauna, No. 7. Both publications were issued in 1893. The Contributions from the U.S. National Herbarium contains a rather complete list of the plants, together with numerous notes on distribution and habits of growth; the N. A. Fauna volume has a chapter on the trees and shrubs, one on the cactuses and yuccas as well as others on the birds, reptiles, amphibians, fishes, insects and mollusks. Dr. Coville, Mr. Funston and Dr. Merriam collected most of the plants. Numerous responsible well trained botanists have since visited the area and made collections. Dr. Coville revisited Death Valley twice in 1931 and at the time of his death in 1937 was preparing to make a further report on the area's flora. A few preliminary notes were published in collaboration with C. V. Morton in 1935 and 1936 as a supplement to the 1893 plant list. Mr. M. French Gilman (1874-1944) was in the Valley from 1933 to 1940 acting first as public contact man of the newly created Monument and later as botanist and nurseryman. His devotion to his nursery of native plants and small botanical garden prompted

The Devil's Cornfield along State Highway 190 *near Stovepipe Wells Hotel, where the winds have eroded away the sand floor of the desert, and left clumps of arrowweed on tiny dunes held together by their roots.*

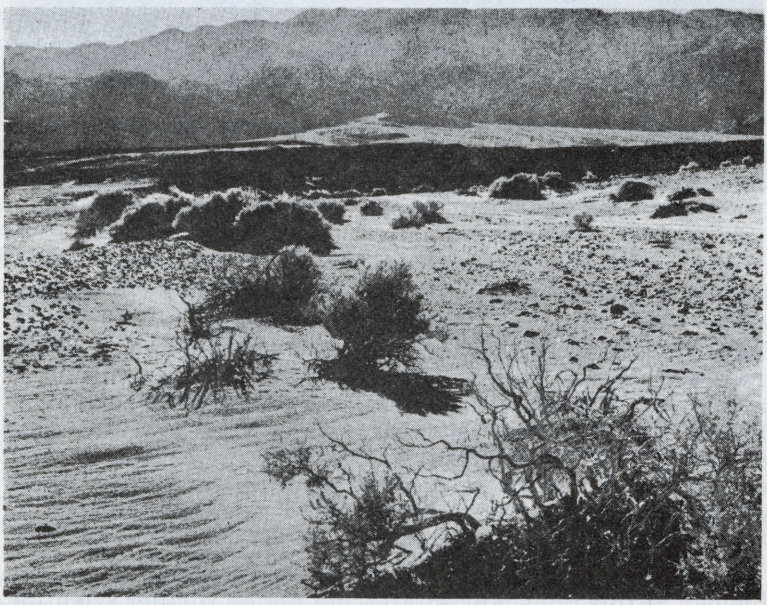
him to valiantly remain in the Valley during the stifling torrid heat of several summers. Mr. Gilman and his assistant, Willard E. Shanteau, collected many plants not before recorded. Due to his assiduous collecting in places difficult to reach, Mr. Gilman's name became attached to several of Death Valley's most unusual plants. One generic name *Gilmania,* was created by Dr. Coville to honor him and six or more new plants he discovered bear the specific name *gilmani;* and so is perpetuated for all time the memory of this ardent and intelligent student of the Death Valley flora.

Before it can be said we know all we should about the biology of this unusually interesting region further scientific observations are necessary.

Because of the great differences in elevation and consequent variance in rainfall, the different range of exposures

to sun and to winds, some of which are exceedingly hot and dry, also the many kinds of soils and terrain, Death Valley National Monument shows a very great diversity of plant forms. The seemingly barren Valley floor and surrounding barrancas and bahadas are alone the home of several hundred species. Add to these the much greater number of trees, shrubs, perennial herbs and annuals of the mountian areas and you have a list of more than 600 species for the whole Monument. I make no attempt to describe or even list more than a small part of these. I am interested here in presenting only a few kinds that are of most constant interest to the greatest number of visitors. For the serious student of Death Valley's unique flora, a special, rather recent, checklist of most of the known species is given in George Palmer Putnam's *A Death Valley Handbook*. See also *Death Valley Wild Flowers* by Ferris.

The below-sea-level flats with their washes, alkali and salt pans, sandy washes and dunes cover an area of almost



Saltbrush and burroweed in dry bed of the Amargosa River. The same winds that scoured clean the wash carried sands upon the hillsides.

fifty square miles. Because of the high salt and alkali content of much of the soil, special plants known to botanists and soil specialists as halophytes (Gr. salt + plant) predominate. Most often noticed and best known of these is the desert holly, a low rounded or straggling shrub with almost white to purplish holly-like leaves. It flourishes in some of the hardest, rocky soils, especially in the washes; great heat and full exposure of Death Valley's brilliant sunshine, it welcomes. After rains its leathery leaves become quite succulent, especially the new ones. Growing with it, especially in spring and after the occasional torrential summer rains, is the annual or perennial honey-sweet, often called *Tidestromia* (Named after the botanist Ivar Tidestrom.) It too has silvery white leaves but instead of being edged with teeth, they have plain borders and are smaller and oval to oblong. I have several times crossed the Valley in early September and noticed the fragrance and beauty of this small rounded plant as it flourished after rains. Its leaves had taken on a beautiful purplish tinge.

There are several other salt bushes besides desert holly which impress us with their gray-green to silvery green foliage. Around Furnace Creek is the deep-rooted woody-stemmed four-wing saltbush, so called because of the four crinkled wings of the seed. Very common is the shadscale or spiny saltbush, with blunt-ovate to spatulate leaves much crowded on the stem. When the leaves dry and drop off the branchlets persist as spines. At Saratoga Springs look for the wedge-leaf orach (*Atriplex phyllostegia*) known particularly for its beautiful trowel-shaped leaves. This is a rather rare saltbush. I have collected it also near Trona. The largest of the saltbushes is the gray-green quailbush (*Atriplex lentiformis*). The leaves of all of the salt bushes often taste salty when touched by the tongue.

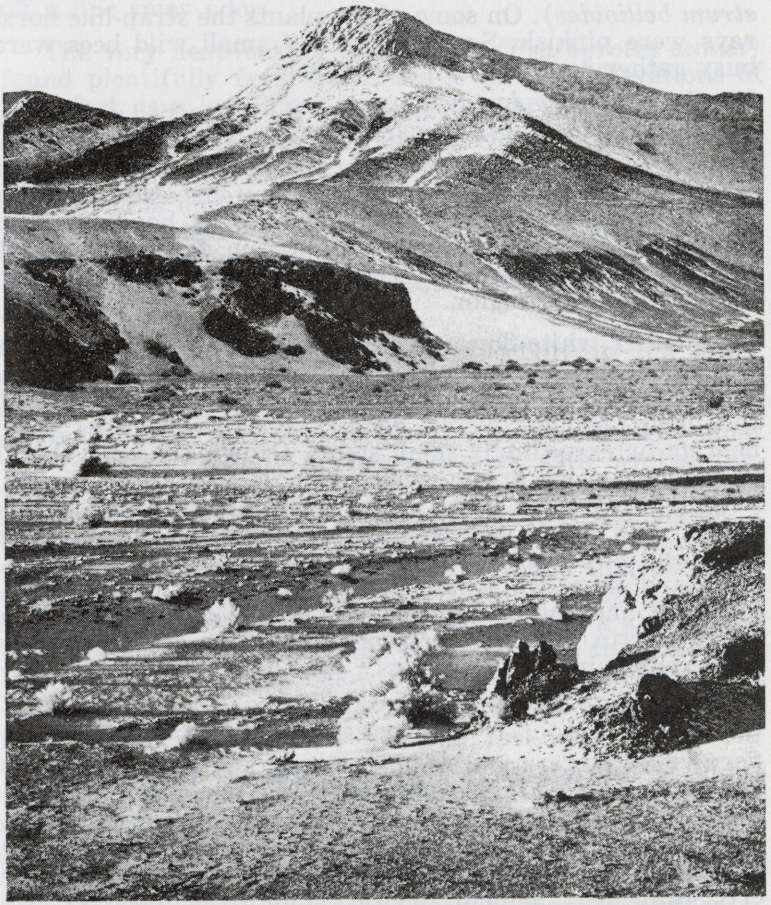
There are three other members of the Goosefoot Family you should know. All are partial to alkali and salt soils. The pickleweed (*Allenrolfia occidentalis*), grows abundantly on most of the salt flats and at Badwater. Its fat many-jointed stems are a bright light green. The true greasewood (*Sarcobatus vermiculatus*) is sometimes called caterpillar greasewood because of the green worm-like male flower spikes. It is a very much branched, stiff-twigged shrub with narrow fleshy leaves. The iodine bush (*Sueda suffrutescens*), also called inkweed, always looks unkempt and half dead because of the many brown, wilted or dead succulent leaves.

It is found in places of excessive soil salinity. The young shoots may well have been among the sources of spring greens for the Panamint Indians. The Pima Indians of Arizona and Sonora so used them.

While on a drive from Furnace Creek to Ubehebe Crater one recent April day I saw along the roadside many specimens of the inflated stem buckwheat (*Eriogonum inflatum*). It was easily identified by its several long green stems with elongated air-filled inflations. Along with it were many rounded brittle bushes (*Encelia farinosa*) with gray-green leaves and yellow daisy-like flowers arranged in loose clusters on elongated yellowish stems which emerged well above the shrub's dome-shaped leafy surface. Another remarkable shrub is the yellow-flowered bebbia (named after M. S. Bebb, a specialist on willows). Its numerous oft-dividing, slender, almost leafless branchlets end in yellow heads of tiny sweet-smelling rayless florets. French Gilman, Death Valley Monument's first botanist, called this plant the chuckawalla's delight because it is such a favorite food of that large vegetarian lizard of the rocks. I seldom walk by a flowering bush of bebbia without pressing some of the blossoms to my nose. Their odor is among the most pleasing of all desert flowers.

Quite abundant too was the perennial desert hollyhock, (*Sphaeralcea ambigua*). Its handsome cup-shaped brick-red to apricot-colored flowers have earned for it the name of apricot mallow. The green roundish-cordate leaves are divided into three to five parts.

Scattered among the shrubs were many flowering annuals. Among the most often seen was the tall, graceful-stemmed, chrome-flowered desert sunflower, (*Geraea canescens*). In places it was so plentiful that it colored the washes a brilliant gold. Scattered here and there in masses too, were the yellow-flowered primrose, (*Oenothera brevipes*), having almost foot-high stems and usually pinnate leaves arranged in a rosette at the base. Scattered in between were clumps of the small white-flowered primrose (*Oenothera scapoidea*). Attractive were the many specimens of the globe-mallow or five-spot (*Malvastrum rotundifolium*) so called because of the red-purple spot just below the middle of each of the five rose-pink, cupped petals. The rounded leaves and upright stems were covered with long bristle-like hairs. The parachute plant, also called tobacco weed (*Atrichoseris platyphylla*) having white chicory-like



Bed of the Amargosa River which has cut into the base of an alluvial fan issuing from a large canyon to the west. The shrubs are salt bushes (Atriplex).

blossoms arranged at the ends of the tall several-branched stems, and tongue-shaped leaves, lying flat on the ground, was rare to plentiful in some of the more rocky roadside washes. We found the odor of the dainty flowers was much like that of bebbia—very sweet and vanilla-like.

Lying almost flat to the ground among the small stones was the yellow-centered, daisy-like desert star (*Eremiastrum bellioides*). On some of the plants the strap-like floral rays were pinkish. Several kinds of small wild bees were busy gathering the nectar and pollen.

We could not fail to notice in the disturbed soil along the roadside, a rather tall dark green plant with begonia-like leaves. It is called wet leaf (*Boerhaavia annulata*) and is a perennial with one to several stout stems, each of which has a noticeable dark green mucilaginous band on each internode. The small pink flowers are in dense clusters at the ends of the branches. This plant is known only from the Death Valley region.

Another white-flowered gem that claimed out attention was a chaenactis often called pebble pincushion (*Chaenactis carphoclinia*). It seemed to grow by preference on some of the driest pebble-covered flats. The dainty flowers were held up by exceedingly small stems. Growing alongside and in between were green spiny herbs (*Chorizanthe rigida*) with rigid, woody stems from which sharp broad spines diverged in every direction. Dried plants of the previous year, and now turned dark brown-purple, were still intact. Here and there we found other chorizanthes of six kinds, all small and rather compact and with leaves mostly in a basal rosette. The tiny flowers of all were surrounded by numerous spiny-tipped bracts.

Flowers of the water-leaf family were represented by the showy notch-leaf phacelia (*Phacelia crenulata*) with deep-violet flowers and reddish stems, and the pale lemon-yellow flowered whispering bells (*Emmenanthe penduliflora*), the dignified caltha-leaf phacelia (*Phacelia cathifolia*) and a low growing, purple-flowered nama (*Nama demissa*). Nowhere abundant but widely scattered was the erect-branched Spanish needle (*Palafoxia linearis*). Its dark green leaves are narrow lanceolate and the urn-shaped rayless flower heads, lavender. It is an annual (sometimes a perennial) that I see on deserts from Mexico to Utah.

Several times there came to my attention low twiggy bushes almost smothered by small wine-colored blossoms. This was a krameria (*Krameria parvifolia*). Examination showed that already the small spiny one-seeded pods were forming. Often beside the krameria grew low to the ground the handsome perennial herb called *Dalea mollis* by the botanists. Its divided silky gland-dotted leaves and soft-

hairy calyces, almost hiding the small pink-tinged white flowers, were most appealing. When crushed the leaves gave off a fine spicy odor.

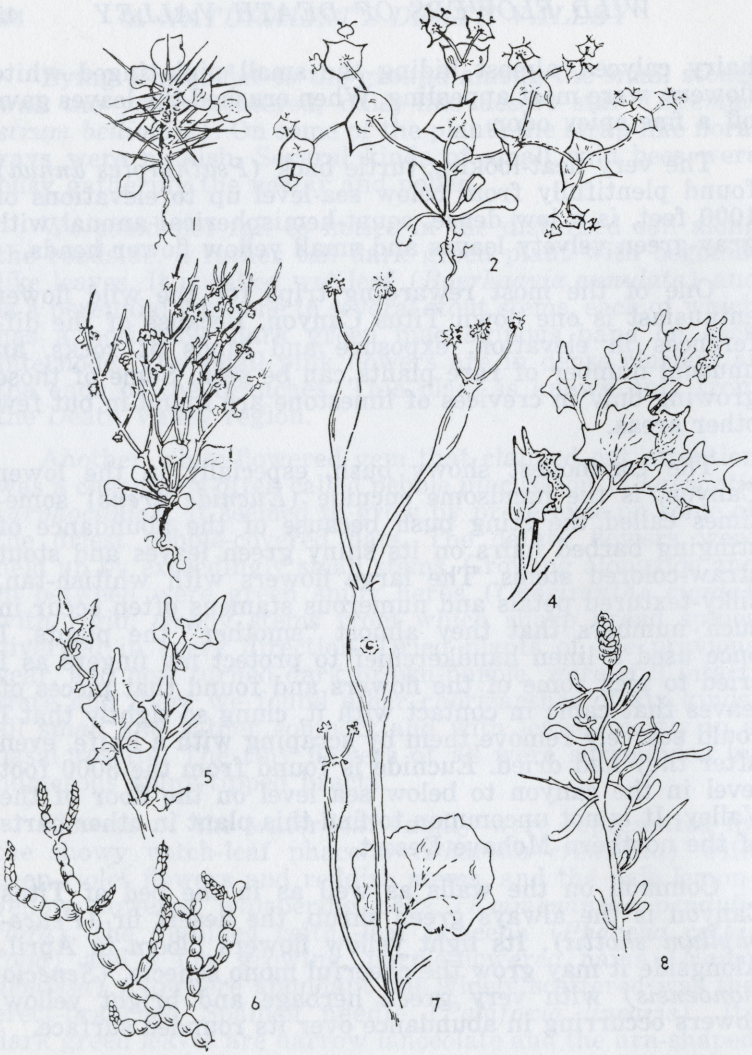
The very neat-looking turtle back (*Psathyrotes annua*) found plentifully from below sea-level up to elevations of 1000 feet, is a low dense, squat-hemispherical annual with gray-green velvety leaves and small yellow flower heads.

One of the most rewarding trips for the wild flower enthusiast is one down Titus Canyon. Because of the differences in elevation, exposure and kinds of rocks, an unusual number of rare plants can be seen. Some of those growing only in crevices of limestone are found in but few other areas.

The commonest showy bush, especially in the lower Canyon, is the handsome eucnide (*Eucnide urens*) sometimes called the sting bush because of the abundance of stinging barbed hairs on its shiny green leaves and stout straw-colored stems. The large flowers with whitish-tan, silky-textured petals and numerous stamens often occur in such numbers that they almost "smother" the plants. I once used a linen handkerchief to protect my fingers as I tried to pick some of the flowers and found that pieces of leaves that came in contact with it, clung so tightly that I could scarcely remove them by scraping with a knife, even after they had dried. Eucnide is found from the 3000 foot level in the canyon to below sea level on the floor of the Valley. It is not uncommon to find this plant in other parts of the northern Mohave Desert.

Common on the walls as well as in the bed of Titus Canyon is the always green shrub, the desert fir (*Peucephyllum shottii*). Its light yellow flowers bloom in April. Alongside it may grow the cheerful mono senecio, (*Senecio monoensis)* with very green herbage and bright yellow flowers occurring in abundance over its rounded surface.

Look diligently on rocky walls as well as in the canyon bottom for the napkin-ring buckwheat (*Eriogonum intrafractum*), a real Death Valley oddity. It is given this name because when the plants are old the bark of the stems falls away revealing a series of sections or joints which appear like tiny napkin rings. These finally become unjointed and fall to the ground. This is a perennial buckwheat with erect leafless stems often 3 to 4 feet long, at the ends of which are found the small groups of flowers.



1. *SPINY HERB*
   (Chorizanthe rigida)
2. *PUNCTURED BRACT*
   (Oxytheca perfoliata)
3. *WHISK BROOM*
   (Eriogonum nidularium)
4. *DESERT HOLLY*
   (Atriplex hymenolytra)
5. *ARROW SCALE*
   (Atriplex phyllostegia)
6. *PICKLEWEED*
   (Allenrolfia occidentalis)
7. *INFLATED STEM*
   (Eriogonum inflatum)
8. *GREASE WOOD*
   (Sarcobatus vermiculatus)

9. *NAPKIN RING*
(Eriogonum intrafractum)

10. *GOLDEN CARPET*
(Gilmania luteola)

11. *JACKASS CLOVER*
(Oxystylis luteola)

12. *WET-LEAF*
(Boerhaavia annulata)

13. *DESERT GOLD POPPY*
(Eschscholtzia glyptosperma)

14. *LITTLE GOLD POPPY*
(Eshscholtzia minutiflora)

15. *WISHBONE BUSH*
(Mirabilis bigelovii retrorsa)

16. *PRINCE'S PLUME*
(Stanleya elata)

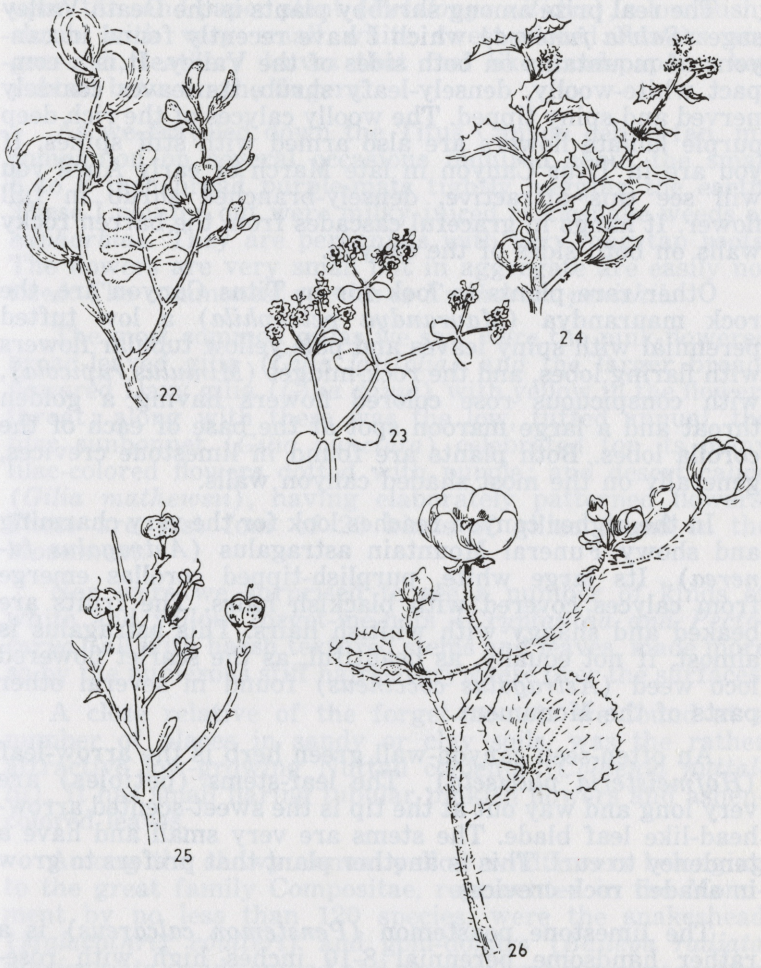
17. *BLACKBRUSH*
(Coleogyne ramosissima)

18. *MOUNTAIN MAHOGANY*
(Cercocarpus ledifolius)

19. *HONEY MESQUITE*
(Prosopis juliflora)

20. *FREMONT'S DALEA*
(Dalea fremontii)

21. *SILK DALEA*
(Dalea mollis)



22. LAYNE LOCOWEED
(Astragalus layneae)

23. DEATH VALLEY EUPHORBIA
(Euphorbia vallismortae)

24. HOLLY-LEAF SPURGE
(Tetracoccus ilicifolia)

25. THAMNOSMA
(Thamnosma montanum)

26. FIVE-SPOT
(Malvastrum rotundifolium)

The real prize among shrubby plants is the Death Valley sage *(Salvia funerea)* which I have recently found in canyons of mountains on both sides of the Valley. It is a compact white-woolly, densely-leafy shrub, its leaves coarsely nerved and spiny tipped. The woolly calyces of the rich deep purple labiate flowers are also armed with stiff spines. If you are in Titus Canyon in late March or early April you will see this attractive, densely-branched shrub in full flower. It hangs in graceful cascades from the barren rocky walls on both sides of the canyon.

Other rare plants to look for in Titus Canyon are, the rock maurandya (*Maurandya petrophila*) a low tufted perennial with spiny leaves and pale yellow tubular flowers with flaring lobes, and the rock-midget (*Mimulus rupicola*), with conspicuous rose colored flowers having a golden throat and a large maroon spot at the base of each of the corolla lobes. Both plants are found in limestone crevices, generally on the most shaded canyon walls.

In the higher canyon reaches look for the very charming and showy Funeral Mountain astragalus (*Astragalus funerea*). Its large white, purplish-tipped corollas emerge from calyces covered with blackish hairs. The fruits are beaked and shaggy with whitish hairs. This astragalus is almost, if not equally, as beautiful, as the scarlet flowered loco weed (*Astragalus coccineus*) found in several other parts of the Monument.

An often-seen canyon-wall green herb is the arrow-leaf (*Hofmeisteria pluriseta*). The leaf-stems (petioles) are very long and way out at the tip is the sweet-scented arrowhead-like leaf blade. The stems are very small and have a tendency to curl. This is another plant that prefers to grow in shaded rock crevices.

The limestone penstemon (*Penstemon calcareus*) is a rather handsome perennial 8-10 inches high with rose-purple tubular flowers crowded on its several straight stems. It is known from upper Titus Canyon and in several other mountainous areas at elevations of 4000-5000 feet.

Beyond the lower end of Titus Canyon where it emerges from between its narrow walls a quite different assemblage of plants occurs. Here are the hardy sun-loving species, among them several kinds of blazing stars (*Mentzelia*) with bright yellow flowers. The seeds of these were annually harvested by the Panamint Indians. Here too you may come

upon the sand paper plant (*Petalonyx nitidus*), a low bushy shrub with very small white sweet-odored flowers and greenish, leathery leaves that feel like sand-paper when rubbed between the fingers.

As we traveled down the Titus Canyon debris-fan, my companion on several occasions inquired about the small 6 to 8 inch broad purple-mats tightly hugging the earth. These I pointed out were milky-juiced rattlesnake weeds or *euphorbias*. They are perennials with very long tap roots. The flowers are very small but in aggregate are easily noticed. The commonest species is *Euphorbia parishii*.

The most common gilias we saw were the pink-flowered broad-leaved gilia (*Gilia latifolia*) and the larger broad-flowered Davy gilia (*Gilia davyi*) with yellow in the flower-throat; along with these was the low, tufted annual, the lilac sunbonnet (*Gilia punctata*) celebrated for its many lilac-colored flowers dotted with purple; and desert calico (*Gilia mathewsii*), having elaborately patterned flowers. These are just four of 20 kinds of gilias found in the Mounment.

Nor were we surprised to see a number of kinds of white and yellow forget-me-nots (*Cryptantha and Pectocarya*) all with harsh textured stems and leaves, made more so by the numerous stiff hairs everywhere over the surfaces.

A close relative of the forget-me-nots we found at a number of places in sandy or clay soils, was the rather attractive low-growing Nuttall coldenia (*Coldenia nuttallii*). It has small flaring tubular pinkish flowers and ashen-colored leaves.

Among the showy annual yellow wildflowers belonging to the great family Compositae, represented in the Monument by no less than 120 species, were the snakeshead (*Malacothrix coulteri*) and gold-dollars (*Baileya radiata pleniradiata*) wide spread and showy along desert roadsides from Death Valley, southern Nevada and Utah to Mexico.

Another roadside plant is the Inyo prince's plume (*Stanleya elata*). It is a perennial which is wide-spread in the entire Death Valley region. It has broad, elongate leaves. The slender flower stems may be two to four or even six feet high and bear long plumes of "spidery" yellow flowers. Less often seen is another prince's plume (*Stanleya pinnata*) with much divided leaves and larger plumes of flowers. The Indians used both species for greens.

Thirteen species of cacti occur in the Monument. They grow only in among rocks or on the well-drained soils of detrital fans. Because of their dislike of saline and alkaline soils they do not grow in the below-sea-level flats.

The most spectacular cactus is the cotton-top (*Echinocactus polycephalus*) so called because the fruits are thickly covered with white cottony matted hairs. It is usually not the small greenish-yellow and fragrant flowers that call our attention to this cactus but the groups of globular to columnar spine-covered stems five to six inches in diameter and eight to ten inches high. They grow in clumps of 10 to 30 and are often called Mohave Red-heads. The seeds were one of the standby foods of the Indians. Especially large colonies of cotton-top cactus are found on the rocky road to The Racetrack.

For sheer beauty few flowers can match the lovely large magenta flowers of the flat-stemmed beaver tail cactus. (*Opuntia basilaris*). It is probably the most common cactus in the Death Valley area and occurs from near sea-level to the tops of the surrounding mountains. The elongate gray-green to purplish flat pads are apparently spineless but each has collections of very small spinules in the numerous areoles. These are indeed difficult to remove from the skin.

The cane cacti, so common farther south on the Sonoran deserts, are here only sparingly represented. The straw-top cholla (*Opuntia echinocarpa*), so called because of its straw colored spines, grows as a robust branched shrub up to 4 or 5 feet high on many gravelly slopes at elevations between 2000 and 3500 feet.

In the mountains surrounding the Valley sink, at elevations between 3000 and 4000 feet two kinds of small nipple cacti grow: the fish-hook cactus (*Mammillaria microcarpa*) and the cork-seed cactus (*Pellosperma tetrancistra*). Both species grow either under shrubs or between rocks and so are rather inconspicuous. The fish-hook cactus has one long hooked spine, surrounded by short radials, on each nipple, whereas the cork-seed cactus has either 3, 4, or 5 brown hooked spines surrounded by white radials on each columnar nipple. The dainty flowers of both species are about an inch across and amaranth-pink. As the flowers fade their place is soon taken by bright red nipple-shaped fruits which are edible.

You must go back into the higher parts of the Funeral

Mountains (3500 to 5000 feet) if you wish to find the rare bee-hive cactus (*Ferocactus johnsonii*). It is a single stemmed species 4 to 5 inches in diameter; sometimes it reaches a height of 16 inches. It is densely clothed with long straight spines which vary in color from nearly white to light pink or a dull dark purple. The flowers, fully two inches across, are pink.

The large barrel cactus (*Ferocactus acanthodes*) is very rare.

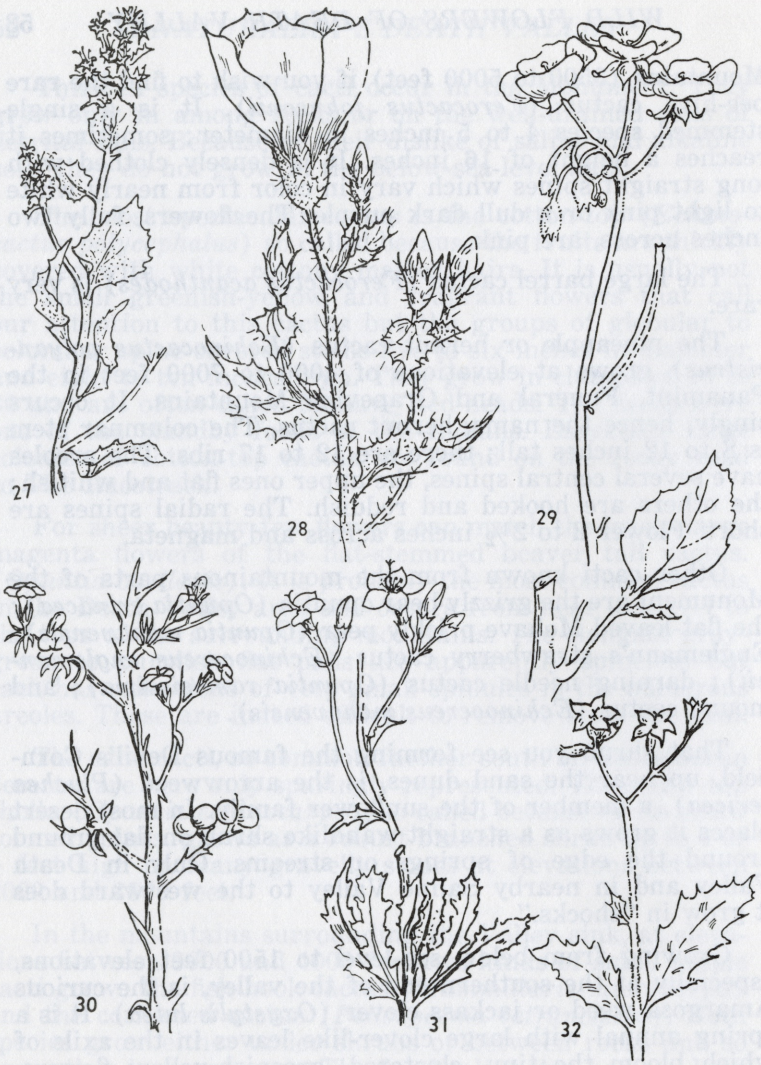
The pineapple or hermit cactus (*Echinocactus polyancistrus*) grows at elevations of 4000 to 7000 feet in the Panamint, Funeral and Grapevine Mountains. It occurs singly, hence the name, hermit cactus. The columnar stem is 8 to 12 inches tall; there are 12 to 17 ribs. The areoles have several central spines, the upper ones flat and whitish; the others are hooked and reddish. The radial spines are short. Flower 2 to 2½ inches across and magneta.

Other cacti known from the mountainous parts of the Monument are the grizzly bear opuntia (*Opuntia erinacea*); the flat-leaved Mohave prickly pear (*Opuntia mohavensis*); Englemann's strawberry cactus (*Echinocereus englemannii*); darning needle cactus (*Opuntia ramosissima*); and mound cactus (*Echinocereus mohavensis*).

That shrub you see forming the famous Devil's Cornfield, up near the sand dunes, is the arrowweed (*Pluchea sericea*), a member of the sunflower family. In most desert places it grows as a straight wandlike shrub on flat ground around the edge of springs or streams. Only in Death Valley and in nearby Saline Valley to the westward does it grow in "shocks."

Growing from below sea-level to 1500 feet elevations, especially at the southern end of the valley, is the curious Amargosa weed or jackass clover (*Oxystylis lutea*). It is a spring annual with large clover-like leaves in the axils of which bloom the tiny, clustered, greenish-yellow flowers. On wet years it may grow to a height of six feet but during years of lean rains it may blossom when not over an inch high.

Four species of poppies grow within the Monument. On the salt and alkali-free flats and higher up you may find the pygmy poppy (*Eschscholtzia minutiflora*), a plant with spreading stems and very small yellow flowers. Next to it may be growing the larger-flowered desert gold poppy



27. *SANDPAPER BUSH*
(Petalonyx nitidus)

28. *STING BUSH*
(Eucnide urens)

29. *YELLOW CUPS*
(Oenothera brevipes)

30. *SPINY MENODORA*
(Menodora spinosa)

31. *DAVY GILIA*
(Gilia davyi)

32. *TOOTH-LEAVED GILIA*
(Gilia leptomeria)

33. *DESERT FIR*
(Peuceplyllum shottii)

34. *ARROW-LEAF*
(Hofmeisteria pluriseta)

35. *GOLDENHEAD*
(Acamptopappus sphaerocephalus)

36. *LEATHER-LEAFED VIGUERA*
(Viguera reticulata)

37. *LARGE-FLOWERED SUNRAY*
(Enceliopis covillei)

38. *LINEAR-LEAVED GOLDEN BUSH*
(Haplopappus linearifolius)

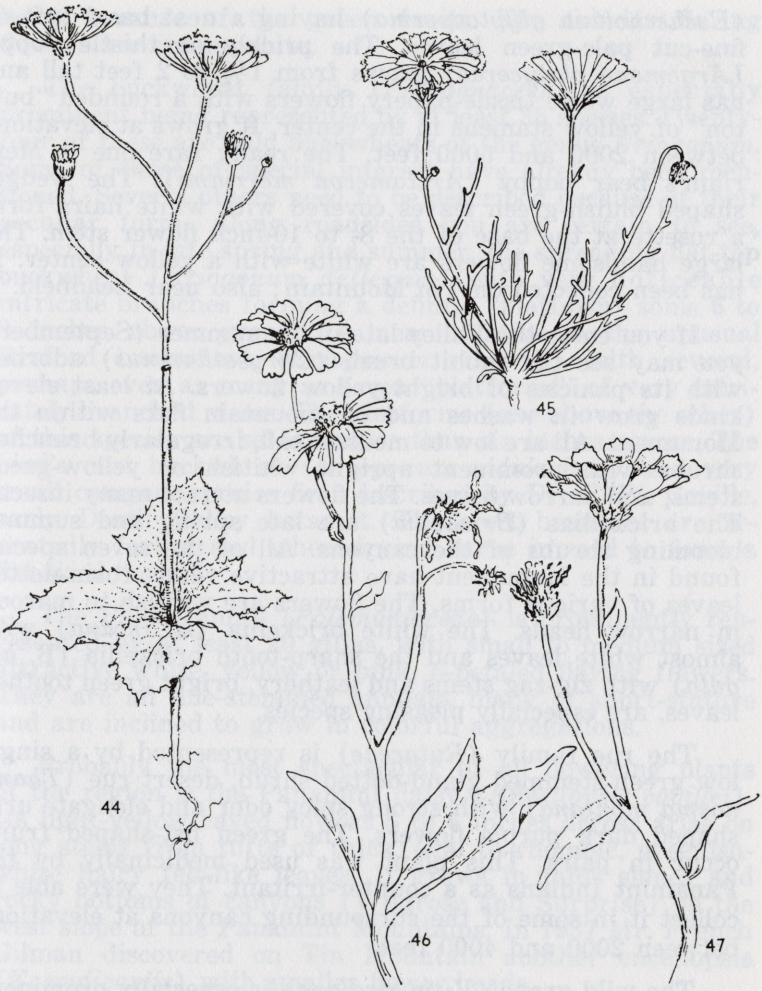
39. *PEBBLE PINCUSHION*
(Chaenactis carphoclinia)

40. *THREE-TOOTHED SAGE*
(Artemisia tridentata)

41. *CHUCKAWALLA'S DELIGHT*
(Bebbia juncea aspera)

42. *SPANISH NEEDLE*
(Palafoxia linearis)

43. *SNAKE'S HEAD*
(Malacothrix coulteri)



44. *PARACHUTE PLANT*
(Atrichoseris platyphylla)

45. *DESERT DANDELION*
(Malacothrix californica)

46. *BRITTLE BUSH*
(Encelia farinosa)

47. *DESERT SUNFLOWER*
(Geraea canescens)

(*Eschscholtzia glyptosperma*) having a neat basal tuft of fine-cut pale-green leaves. The prickly or thistle poppy (*Argemone platyceras*) grows from 1½ to 2 feet tall and has large white tissue-papery flowers with a rounded "button" of yellow stamens in the center. It grows at elevations between 2000 and 5000 feet. The really rare one is Merriam's bear poppy (*Arctomecon merriami*). The wedge-shaped bluish-green leaves covered with white hairs form a rosette at the base of the 8- to 10-inch flower stem. The large handsome flowers are white with a yellow center. It has been collected on Tin Mountain; also near Leadfield.

If you enter the Valley late in the summer (September) you may see the rabbit brush (*Chrysothamnus*) adorned with its panicles of bright yellow flowers. At least eleven kinds grow in washes and on mountain flats within the Monument. All are low to medium tall, irregularly branched shrubs with prominent upright whitish or yellow-green stems, and narrow leaves. The flowers attract many insects. The brickellias (*Brickellia*) are late spring and summer blooming shrubs of the canyons. All of the seven species found in the Monument have attractive veiny, rosin-dotted leaves of various forms. The flowers are whitish to maroon in narrow heads. The white brickellia (*B. incana*) with almost white leaves and the sharp-tooth brickellia (B. *arguta*) with zig-zag stems and leathery, bright green toothed leaves, are especially pleasing species.

The rue family (*Rutaceae*) is represented by a single low green-stemmed gland-dotted shrub, desert rue (*Thamnosma montana*) with strong spicy odor and elongate urn-shaped dark purple flowers. The green fist-shaped fruits occur in pairs. This plant was used medicinally by the Panamint Indians as a counter-irritant. They were able to collect it in some of the surrounding canyons at elevations between 2000 and 4000 feet.

The wild grape (*Vitis girdiana*) is especially prominent about springs on the east side of the northern half of the Valley, although not confined there. The grapes when ripe were a welcome addition to the Panamint Indian's meager diet.

In higher parts of Dante's Canyon, at Chloride Cliff and on the Leadfield Grade I ask you to look for the low shrubby, double-fruited spiny menodora (*Menodora spinescens*), sometimes erroneously called a Death Valley goose-

berry because of the green fruits. The tubular flaring flowers are cream-white.

The buckwheat family (*Polygonaceae*) is especially prominent, being represented by at least 35 species. Twenty-four of these are wild buckwheats of the genus *Eriogonum*. Some of those of special interest have already been mentioned. Several others need to be described because of their peculiar form. Along roadsides you are certain to see, especially in late spring and summer, the spreading flat-top buckwheat (*Eriogonum deflexum*) with very noticeable intricate branches forming a definite "platform" some 6 to 8 inches above ground. A near relative is the unusual Rixford buckwheat (*Eriogonum rixfordi*) with several, perhaps even as many as seven "platforms" of very intricately branched stems. The platforms (one above the other) of this species are seldom more than six inches across. The bird's nest buckwheat (*Eriogonum nidularium*) is a very small compact species first described by Dr. F. W. Coville, early Death Valley botanist. The erect branches are repeatedly forked and when drying curve inward to form a fist-sized "nest."

The Phlox family (*Polemoniaceae*) is prominently represented by at least 20 gilias, with small to medium sized attractive white, yellow or pink, 5-petaled flaring flowers. They are all fine-stemmed annuals, many of short-stature and are inclined to grow in colorful aggregations.

Probably the most spectacular of all flowering plants of the region is the Panamint daisy (*Enceliopsis covillei*). Its light-yellow rayed flowers 5 to 6 inches across arise on long stems from tufts of thick, oval to rhombic, greenish-white hairy felt-like leaves. It grows in talus slopes and rocky bottoms of canyons (Wildrose and Surprise) on the west slope of the Panamint Mountains. In 1937 Mr. French Gilman discovered on Tin Mountain another enceliopsis (*E. nudicaulis*) with smaller flower heads.

The desert or squaw teas (*Ephedra*), of which there are five kinds in the Monument, are low cone-bearing shrubs with slender jointed stems, and leaves reduced to scales. The mountain ephedra (*E. viridis*) has vivid yellow-green stems in broom-like bunches, whereas the Nevada ephedra (*E. nevadensis*) has gray-green loosely arranged stems. The latter is the common kind in the low hot portions of the Valley. The rare Death Valley ephedra (*E. funerea*) grows in the Funeral Mountains near Ryan.

Thirty-eight grasses have been collected in areas high and low. Among the four most common and important ones are: (1) Indian rice grass (*Oryzopsis hymenoides*) which has long been so valuable to the Indians for its seeds, (2) salt grass which grows in damp salt-impregnated soils at such places as Badwater, Salt Creek and Furnace Creek (many folks mistake it for Bermuda grass), (3) desert needle grass (*Stipa speciosa*) a beautiful bunch grass of the mountains, and (4) the dainty fluff grass (*Triodia pulchella*), a low tufted perennial which in spring often appears as if covered with frost, hence its other common name, frost grass. It is found mostly on the low deserts.

If you wish to find ferns you must go to the canyons and to the north-facing slopes and cliffs of the mountains. In Hanaupah Canyon and some of the other canyons, carrying water, grows the maidenhair fern (*Adiantum capillus-veneris*) also the Coville lip fern (*Cheilanthes covillei*), the birdsfoot cliff-brake (*Pellaea mucronata californica*) and goldfern (*Pityrogramma triangularis*). The woolly cloak ferns (*Notholaena*) are generally seen at the base of rocks on north slopes. One ground-pine (*Selaginella leucobryoides*) may be observed on the Telescope Peak trail.

Four rushes, grass-like, dark-green herbs with tough pithy stems grow in the alkali soils about springs. Of these the Cooper rush (*Juncus cooperi*) a rather tall "wire grass," and the much shorter, more slender-stemmed Baltic rush (*J. balticus*) are perhaps the most common. If in low wet places you see grass-like plants with triangular stems, you have found one of the sedges of the genus *Scirpus* (bullrush), *Carex* (true sedge) or *Eleocharis* (spikerush).

These flowers I have mentioned and illustrated with pen drawings are only a few of the total number which the plant enthusiast will discover as he travels on foot-trails or by auto on the main- and by-roads of the Death Valley area. If he gets acquainted with only those here described he will have a good start toward a preliminary mastering of Death Valley's unique flora. The reader is referred to the author's *Desert Wild Flowers* and Ferris's *Death Valley Wildflowers* for identification and information concerning other kinds of wild plants he may find.

The road past Saratoga Springs. Desert holly in foreground. The trees are tamarisks (Tamarix articulata). The grass-like plant is a Juncus.

The visitor is asked to enjoy but not to pick or disturb the wild flowers he admires, lest in a land of diminishing rains he helps to exterminate some of the vanishing species. The good rule is: *enjoy, not destroy.* There is no restriction placed on photographing or making drawings or paintings. By these means you can take home with you memories of the best of the area's floral beauties.

Antelope ground squirrel

CHAPTER IX

Fossils . . .

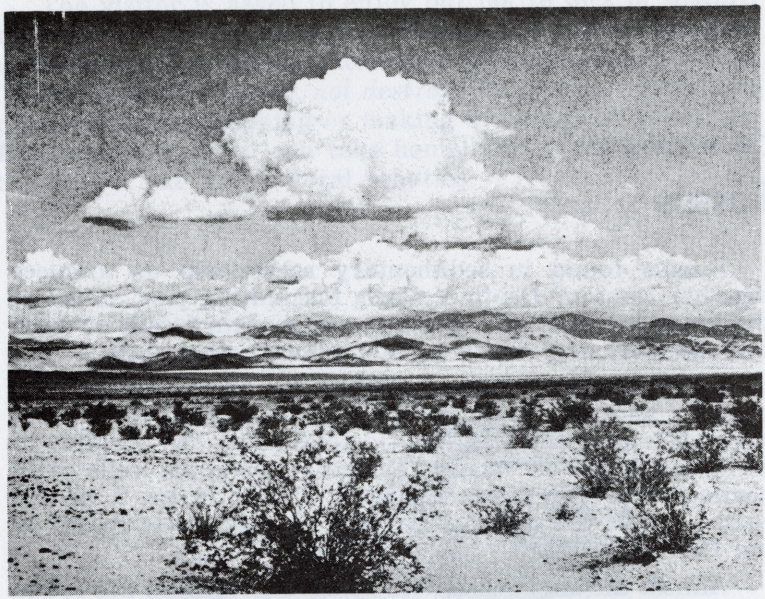
Fossils found in sedimentary rocks help us to piece together some of Death Valley's fascinating past. Some of the limestone beds of Algonkian age contain fossils of what may possibly be primitive water plants called algae.

Many strata of Paleozoic rocks are represented at one place or another. Some contain fossilized parts of sea animals such as sea-lily (*crinoid*) stems; also, the remains of honey-comb corals having elongate polygonal cells with perforated walls. These favositid (Latin *favus,* a honeycomb) corals are among the most characteristic fossils of the Paleozoic Era.

Almost the only rocks with remains of animal life found to date in the region's Tertiary (Oligocene) beds occur in the Titus Canyon formation of red sandstones near old Leadfield. These include a Titanotherium (a rhinoceros-like animal with heavy flattened skull bearing two divergent, bony, hornlike protuberances), a small horse and some primitive rodents, dogs, camelids, deerlets, tapirs, creodonts and brontotheres. Their presence suggests a country well-watered, well-wooded and with many interspersed savannas. All this is difficult to imagine as we look over the present area, with mountains so precipitous, rocky, barren and extremely arid.

Interesting indeed are the fossil footprints of birds and mammals that have been discovered in some of the Tertiary beds. They represent the tracks of some of the multitude of animals that inhabited the Death Valley region many, many, some say millions, of years ago. The several locations where these tracks are found are in places difficult to reach except on foot. Fossil fish and gastropods (snails) found in other Tertiary beds are of indeterminate age.

The Pliocene sedimentary rocks in Copper Canyon near Ryan contain fossil footprints of many birds, a cougar,



Lower Death Valley just after a winter rain. An almost pure stand of creosote bushes, widely spaced, testifies to the meager supplies of moisture.

a one-toed horse, a camel and an elephant. Says Dr. Thomas Clements (p. 33, Geological Story of Death Valley) : "They (the footprints) were made in the soft mud around the shores of a fluctuating lake as the animals followed the receding waters to quench their thirst, or were followed by hungry carnivores in search of a meal. The fluctuations probably were seasonal, and with the coming on of the rainy season fresh silt and mud filled the imprints as the water rose, preserving them. That this occurred again and again is indicated by the fact that layer after layer contains tracks, each superimposed on the previous ones."

In the Salt Creek Hills lying south of the Sand Dunes and the Devil's Cornfield are sandstones of Quaternary age in which are fossil tracks of several kinds of wading birds, an antelope, peccary (a kind of wild pig), elk, camel and what is probably a horse. They too represent animals that walked around on the shores of ancient water holes or lakes. Their tracks were buried under sand; afterwards the

sands became sandstone. The footprints were later made visible when the sandstones above them were worn away by the down-tearing forces of erosion (chemical disintegration, winds, flowing water carrying grains of sand).

Part of the tusk of a mastodon, an elephant-like animal with peculiar conical-cusped molar teeth and long upper tusks directed nearly straight forward, was found associated with the horizontally lying beds of clay of ancient Lake Rogers which once occupied parts of the north end of the Valley beyond Ubehebe Crater. (See page 6).

Actual fossils of members of the older plant communities are peculiarly lacking insofar as I can learn; but one fossil of a higher plant has been found, that of the Catalina ironwood (*Lyonothamnus*), a tree still found living on some of Southern California's coastal islands. This single fossil is however highly diagnostic and tells us much. Fossils of Pliocene animals that lived contemporaneously with this tree are rather well known. Knowledge of their food habits, particularly of the herbivorous kinds enables us to arrive at quite accurate conclusions regarding the kinds of plants that covered the land.

To the eastward on the Amargosa River, just a short distance outside of the Monument boundary fossilized palm leaves and stems have recently been discovered.

Diatoms, peculiar water-inhabiting near-relatives of the brown algae, have the cell contents enclosed in a wall impregnated with silica and beautifully marked by minute pores or lines. The two over-lapping parts or valves of this flinty covering fit together like the two parts of a Petri dish. Reproduction is very rapid; it has been estimated that a million individuals might arise from one in the period of a month. When diatoms die the minute shells of silica remain. Thus we often find large accumulations of the flinty cases in the form of diatomaceous earth. It is interesting to know that deposits of fresh-water fossil diatoms are now known from Pliocene rocks in the eastern reaches of Furnace Creek.

The New Museum . . .

The new Museum (first opened in 1960 in connection with the dedication of the Visitor's Center) with its splendid exhibits revealing so well the Monument's chief beauties, its fascinating geology and natural history, is outstanding among the many attractions of Death Valley. Visitors to the Monument, especially the newcomers, should spend many hours there. Here are gathered together in very condensed form most of the important information one should know about this fantastic area. Here in a few hours one can learn what has taken years of research of specialists to learn. To the many questions you might ask, here are the answers.

In connection with the Museum's services are the public lectures held in the efficiently appointed lecture hall, and the field trips led by the well-trained and competent staff naturalists. The times when these are held can be ascertained at the information desk near the main entrance to the Visitor's Center.

Do not become so engrossed in mere travels over the Valley's good roads that you fail to thoroughly enjoy the sights and things which become available through the Monument's interpretative services.

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ADDENDA

Park Naturalist, Roland H. Warner, in his *Survey of the Birds of Death Valley* (Condor, Vol. 64, No. 3, May-June, 1962) publishes a list of 232 species of birds observed or recorded for the below-sea-level portions of the Valley—a surprising number indeed for an area so arid. Fifteen of these are known to be resident throughout the year. Included in this resident list are the Red-tailed Hawk, Great Horned Owl, Burrowing Owl, Say Phoebe, Gambel Quail, Common Raven, Mockingbird, Killdeer, House Sparrow and House Finch: there are two water birds, the Pied-billed Grebe and Mallard.

In his summary, Mr. Warner notes that of the 232 species reported from the below-sea-level area 7% are permanent residents, 23% are winter visitants, 41% are migrants and 9% are transients or vagrants. His observations show that the winter visitants leave early in March and that at about the same time the spring migrants begin to move in; a few of these actually nest in the Valley.

June appears to be the time of fewest birds, but in July the number increases in spite of the high temperatures and great dryness, especially in those areas where green vegetation and fresh water can be found.

The first week in August is the time when southwest bound migrants start to arrive. Many of them stay for a protracted period, whereas others may remain only for a few hours to a few days while feeding and taking a temporary rest.

DEATH VALLEY 49ERS
MEMBER